State Water Survey Division
HAZARDOUS WASTE RESEARCH AND INFORMATION CENTER
P.O. Box 5050, Station A
Champaign, Illinois 61820

ENR
Illinois Department of
Energy and Natural Resources

SWS/HWRIC Report 002

HAZARDOUS MATERIALS LABORATORY FEASIBILITY STUDY

September 1984

TECHNOLOGY SOCIETY ACTION ENVIRONMENT

SWS/ HWRIC Rept. 002 c.1
HAZARDOUS MATERIALS LABORATORY FEASIBILITY STUDY

SWS/ HWRIC Rept. 002
HAZARDOUS MATERIALS LABORATORY FEASIBILITY STUDY

Hazardous Waste Research and Information Center
Water Survey Division

Illinois Department of Energy and Natural Resources

HAZARDOUS MATERIALS LABORATORY FEASIBILITY STUDY

September, 1984

Prepared by:

Michael J. Barcelona, Acting Director
with the cooperation of the
HWRIC Research Advisory Committee:

Keros Cartwright (SGS)
William Frerichs (EEA)
James Gibb (SWS)
Robert Gorden (SNHS)
James King (ISM)

CONTENTS

EXECUTIVE SUMMARY

The Hazardous Waste Research and Information Center is a program of the Illinois Department of Energy and Natural Resources. The Center is housed in the Water Survey Division and involves the scientific and engineering staff of all Divisions of the Department. Currently, there are no facilities available for the sampling, storage, chemical or physical characterization of hazardous materials and waste streams which contain unknown hazardous components. In order to carry out its mission to provide research, information, technical and industrial assistance on hazardous waste problems in the State, the Center must provide a facility for the accurate characterization of properties of waste streams and unknown samples. The complete physical and chemical analyses of such samples requires the development of new handling and analytical facilities to insure that exposure hazards to laboratory and related personnel can be minimized. This type of operation must be conducted to adequately control the release of any hazardous materials from the laboratory to the external environment. The proposed facility has been identified as the Hazardous Materials Laboratory (HML).

The proposed laboratory facility should incorporate areas for safety and sampling gear, sample storage, sample preparation and preconcentration. Sufficient analytical capability must be maintained to permit the comprehensive evaluation of the hazardous properties or treatability of wastes and environmental samples. Limited facilities for bench scale testing of various treatment options should be included. To the extent possible, existing laboratory instrumentation should not be duplicated. The criteria for judging duplication should include safety, minimal disruption of ongoing activities in the Center and Divisions, as well as the need to provide new technical support services for a variety of users.

This study provides a preliminary description of essential HML functions and capabilities. Also included is a detailed summary of existing analytical and related facilities of the Department. Due to the nature of the proposed facilities' requirements, it is unlikely that any of the Department's existing laboratory or office space can be renovated to accommodate the needs of HWRIC. There is no suitable space at the University of Illinois available to the Water Survey for either the long-term office or laboratory needs of HWRIC. The most reasonable alternative therefore is to construct the HML and HWRIC office space on the new grounds of the Water Survey at the former Adler Zone Center. This study provides the data necessary for a comprehensive design study to be conducted by a qualified firm.

1.0 IDENTIFICATION OF MAJOR HML FUNCTIONS AND NECESSARY CAPABILITIES

The HML must provide rapid, accurate response to the research and service needs of HWRIC divisional programs and aid in support of the nonroutine demands of the State's environmental regulatory and enforcement agencies. In order to accomplish this mission, the facility must incorporate complementary capabilities for the sampling, storage and analysis of samples containing hazardous materials. The degree of hazard involved in such operations is the most important consideration in determining both the limits of HML operations and the levels of protection which must be afforded to laboratory and related personnel. This section details the anticipated needs of the Department for such a facility. It is our goal to provide the best research, and technical services possible in support of a comprehensive state hazardous waste management strategy.

The principal distinctions between the proposed HML and existing laboratories in ENR arise from the need to both maximize the safety of laboratory personnel and minimize the release of hazardous materials to external environments. The National Research Council has published several guidelines for hazardous chemicals' (or materials) handling in the laboratory.[1] In the transmittal letter from NRC to the Occupational Safety and Health Administration, Philip Handler of the National Academy of Sciences wrote:

> "A balanced approach is presented to the full range of hazards associated with chemicals in a laboratory setting -- risks from fire, explosion, acute toxicity and chronic toxicity, including carcinogenicity. While no set of procedures is likely to make a research laboratory risk-free, the report's thesis is that; with adequate physical facilities [including properly operating ventilation, handling all new substances as though they were toxic until actual toxicological data are available, using appropriate protective clothing and gloves when necessary, and an institutional commitment to a vigorous safety program], the laboratory can be a safe workplace."

These comments underscore the need for the HML to be very carefully planned and designed. HWRIC staff and associated researchers will be handling mixtures of toxic materials, as well as unknowns for which toxicological data is unavailable. The experience of other research facilities is especially helpful to the planning effort.[2,3,4] The key to effective HML design is the versatility of laboratory space to conduct a variety of chemical and physical handling or analysis steps, while maintaining security against unauthorized access or the release of toxic materials by a variety of routes. Ventilation, shower or decontamination facilities and waste water purification are essential to the operation of

a self-contained, first class facility. The interrelationship of these systems and necessary versatility can be best achieved by the construction of a new facility rather than attempting to design the laboratory with the constraints imposed by an existing structure. Harless et al. (4) have detailed the critical considerations of facility design construction and operation which should be taken into account in the design study for HML. It is clear that each facility must be designed for the specific applications envisioned. In the case of HML, office space must be provided for HWRIC's core staff, in addition to the analytical facility.

HML applications will be centered around the safe sampling, preservation, storage, and comprehensive characterization of hazardous wastes and contaminated environmental media (e.g. air, water, soil and biological materials). The ancillary instrumentation and facilities available in the scientific Surveys can be used for analytical work, once the preliminary steps have been completed under controlled conditions which establish the degree of hazard and necessary precautions for handling. This measure of safety will insure that the release of toxic materials is minimized in all HWRIC field and laboratory programs. Strict control of sample custody and ultimate disposition is a minimum requirement for HWRIC activities. Laboratory operation procedures must be developed to insure sample tracking through all stages of material or waste handling to the reporting of results.

A wide variety of gaseous, liquid, and solid samples will be collected in the course of HWRIC's research and assistance programs. It is therefore important that highly versatile sample handling and preparative areas are available in HML. This type of design will permit laboratory staff to prepare for specific types of samples on a demand basis. The Radian facility (4) exemplifies the needed aspects of a versatile design.

The following subsections detail general functional capabilities of HML and currently recognized needs for storage and handling, general use and instrumental laboratory areas for the facility.

1.0.1 SAMPLING AND SAMPLE PRESERVATION

The effective collection of hazardous wastes and potentially contaminated environmental samples are tasks which have a dual nature. First, samples must be collected which will provide results which are representative of the state of a waste stream or environment (e.g. atmosphere, soil or ground water) at the time of sampling. Second, the sampling operations must be conducted with adequate personnel protection which may be afforded by personnel protection equipment (e.g. respirators, suits and gloves) followed by isolation of the samples in transport or handling. Decontamination procedures must also be clearly understood by all individuals involved in sampling, as well as lab staff.

The USEPA has defined four distinct levels of potential hazard at waste sites or in waste handling operations. Each level requires specific precautions against undue exposure which are deemed adequate for short periods of time. These levels, in increasing degrees of apparent hazard, are:

Level D is designated if onsite conditions indicate that exposure to hazardous materials is unlikely. Field personnel wear chemically resistant steel-toe and shank boots, cotton coveralls, outer gloves (when handling samples), hard hats, safety glasses or face shields and have an emergency-escape air-purifying respirator readily available.

Level C is required when the site assessment indicates that hazardous materials exist that will cause illness as a result of personnel exposure, but use of a self-contained breathing apparatus is not necessary. Level C personnel-protection equipment includes a full-face air-purifying respirator, nonwoven or spun-bonded synthetic coveralls with a chemical resistant coating, chemically resistant boots and boot covers, specially formulated rubber gloves, and inner surgical gloves. The materials of construction of these garments vary with the chemicals to be encountered. Emergency-escape air-purifying respirators are carried for backup in the event that the service life of the full-face respirator cartridge is exceeded.

Level B is assigned to any site or handling exposure situation where a determination has been made that the highest level of respiratory protection is required, but that total body isolation is unnecessary. Entry to a Level B site requires the use of the Level C protective clothing plus an open-circuit, pressure-demand, self-contained breathing apparatus.

Level A is designated for extremely hazardous sites and requires total encapsulation of personnel and their air supplies when personnel are engaged in activities in the site's "hot spot" areas.

It is anticipated that few of HWRIC's activities would require level A or B personnel protection without a pre-determined list of target toxic species. In these cases, the resources of the appropriate emergency response, remedial action or regulatory agency would be utilized. HML supervisory staff would require detailed knowledge of the origin, general characteristics and minimum precautions necessary for the receipt of any such samples. Nonetheless, in order to maintain sample control and handling safety measures, emergency capabilities for high level work in the event of accidents would be maintained in the laboratory. The emphasis of HML's sampling safety capability should be on field surveillance and warning instrumentation to insure that adequate safety precautions are being used for the situation at hand. Of course, all sample transport requirements must be at or above the level required by the Illinois Department of Transportation.

Gases (Toxic Vapors, Atmospheric Sampling).

HWRIC research and assistance programs will involve waste stream sampling and sampling during drilling or ground-water/soil core collection operations. Protection for sampling or drill crew staff can be best assured by the use of toxic vapor instruments which respond to a variety of organic vapors and some field equipment to permit qualitative identification of the gaseous contaminants in water samples, bore-holes or core samples. Gas chromatography instrumentation equipped with photoionization detectors suitable for field use are essential in this regard. Facilities for the maintenance and calibration of this instrumentation must be provided. Specialized sampling gear for unique situations, however, will be provided by the group responsible for such activities.

Liquids (Waste Streams, Ground Water)

For these sampling activities, grab or composite samplers which are designed for effective cleaning and decontamination will be used. Waste bailers and submersible pumps should be made of durable, contamination resistant materials: preferably glass, stainless steel and Teflon(R). Sample preservation and storage containers should be tailored for the specific application, allowing for overpacking for transport. These items will also be provided by the involved research or service groups, however HML must insure that storage, handling and preparation steps segregate highly contaminated samples from "background" samples.

Sludges

Waste sludges are perhaps the most deceptively simple samples to collect properly. The gels or semi-solids are most frequently heterogenous in composition and careful compositing is necessary. Sampling gear will often have to be dedicated to specific projects. The sample collection methods vary considerably, but it is necessary that transport contain the solids, as well as any supernatant liquids or evolved gases. Dedicated storage and sample preparation areas will be needed to adequately handle and sub-sample these materials.

Solids (Waste Solids, Soils, Sediments)

The sampling and preservation equipment for waste solid's collections are to some extent provided by the sludge handling needs. Soils and surface water sediments may be contaminated to varying degrees. Field capabilities should include coring and core-transport vessels, as well as instrumentation to quickly assess the relative level of contamination in specific samples.

Biological Tissues and Extracts

In general, HML capabilities for the handling of contaminated biota will be determined by the needs of specific investigators. At the very least, provisions must be made for the containment of the hazardous tissues or degradation products which may accumulate on storage. Precautions for handling biological samples should be more stringent than measures for nonliving materials, since the possibilities for the transfer of pathogenic microbes or parasitic organisms are clearly present.

Safety and HML Operations' Regulatory Compliance

HWRIC is the focus of the state HW research and service activities. It is essential that HWRIC programs reflect a healthy respect for the actual hazards involved in the handling, characterization and treatment of hazardous materials. HML operations must therefore remain in strict compliance with the regulations of appropriate state agencies and the University of Illinois. These operational guidelines should also extend to all projects supported by HWRIC. Routine sampling and laboratory procedures must be developed for a variety of contingencies prior to the initiation of operations.

Staff medical workups, as well as laboratory air and wastewater sampling must be conducted on a routine basis to verify that safety and operations procedures are adequate to contain hazardous constituents and assure personnel safety.

1.0.2 GENERAL FACILITIES REQUIREMENTS

The Hazardous Waste Research and Information Center will ultimately (in 1987) be staffed with eleven core research, service and information professionals, contract laboratory staff and three divisional staff members. Office space for at least fifteen professionals, general use space (e.g. conference room and reception area) and the Hazardous Materials Laboratory will be needed. Ideally, the building should be in close proximity to the Water Survey Division's headquarters. The new Water Survey complex presently being prepared at the former Adler Zone Center in the extreme southwest portion of the University of Illinois-Urbana Champaign campus is expected to be fully operational in 1986. On completion, the HWRIC facility should allow for minimal disruption of SWS activities while assuring traffic access to existing laboratories and emergency plan needs.

Anticipated space requirements, allowing for reasonable expansion of HWRIC commitments and ongoing activities in the next two years, include approximately 4,000 ft^2 of net assignable space in each of three use categories. These categories include: 1) the office and general use space noted above, 2) physical and chemical

analytical space for instrumentation and specialized capabilities currently unavailable to the scientific Surveys, and 3) specialized storage, handling and preparation space for hazardous materials. Categories 2) and 3) comprise the nucleus of HML operations. The office and general use space must be separated from that assigned to HML operations to maintain control for safety and hazardous substance isolation purposes.

The general description of facilities' requirements in categories 2 and 3 are detailed in sections 1.0.3 through 1.0.7 of this study. A schematic diagram of potential HWRIC facility placement is included in Figure 1.1.

1.0.3 STORAGE FOR SAMPLES, SOLVENTS AND STANDARDS

The most critical space requirements apply to the sample, gas cylinder solvent and standard storage areas, together with the facilities needed for decontamination and wastewater/air purification. Approximately 2,500 ft^2 of the category 3) space will be assigned to these uses. A suggested division of the space is provided in Table 1.1 below:

Table 1.1. Space Designation in High Hazard Area of Category 3) Space

Area type	Uses	NASF*
Decontamination	Showers, changing rooms, lab clothing, laundry and contaminated clothing holding	750 ft^2
Wastewater and air treatment facilities	Water treatment equipment, utilities and emergency equipment storage	750
Storage	Sample receiving, sample solvent, standard, gas cylinder storage (50% refrigerated, 25% vented/isolated, 25% vented for bulk items)	600
Handling/ manipulation	High hazard sample, standard handling, packaging areas (fume hood and glove box in each 200 ft^2 room)	400
	TOTAL	2500 ft^2

* NASF = Net Assignable Square Feet not associated with hallways, corridors and air locks or buffer zones

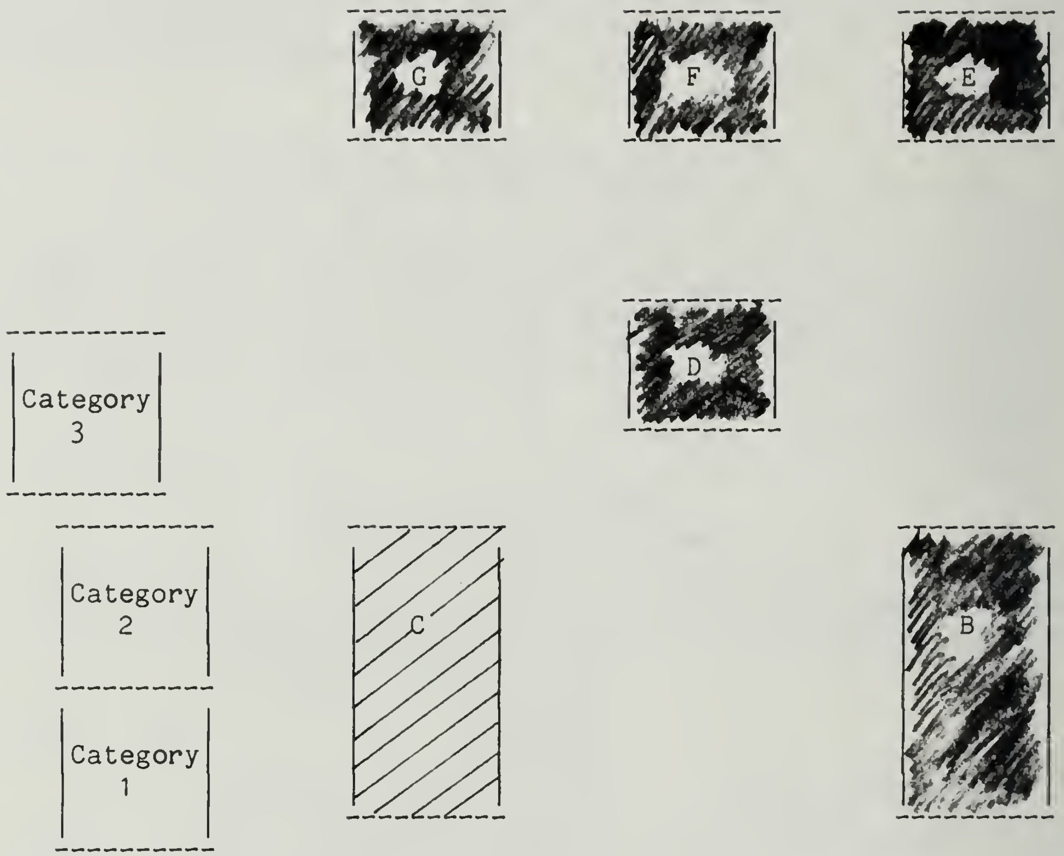

Figure 1.1. Schematic diagram of Adler Zone Center (SWS headquarters) and HWRIC building. Shaded buildings comprise the SWS office ▣ and laboratory ▨ facilities. The HWRIC facilities are keyed to the discussion in the text.

This space must incorporate the maximum safety and emergency equipment capability of HML, since it will be the area in which raw waste samples and unknowns must be handled. The relative nature of the hazards involved in sample handling will be known before materials are allowed to enter the facility. However, there is usually considerable doubt as to the actual acute or chronic toxicity of waste mixtures. Therefore, this area must permit safe handling of these materials in isolation until they can be subsampled and packaged for release into the sample preparation and laboratory handling areas. An operational plan will be formulated to insure that personnel safety and hazardous materials' contaminant procedures are observed at all times. Emergency procedures and alarm systems must be adequate to alert all laboratory and office areas in the event of a release or accident. Hallways, work areas and air locks should be kept at positive pressure with respect to the storage and handling areas. It is expected that they will be well designed with extensive observational windows to facilitate detection of potentially serious conditions as rapidly as possible.

1.0.4 SAMPLE AND STANDARD PREPARATION

The remainder of the category 3) space in HML will be used for bench work on sample preparation (e.g. solvent extraction, drying, volume reduction, bench-scale treatment studies and standardization procedures. Highly hazardous substances will only enter this area in sealed containers or in solutions. Sample sizes and solution concentrations will be maintained below dangerous levels, should an accident result in the release of the hazardous mixture or solution. Physically, this laboratory area could be closer to that of categories 2) and 1) than that described in 1.0.3 used for sample receipt, storage and decontamination areas. A proposed breakdown of the space in this laboratory area is shown in Table 1.2. The major requirements of these areas are to prevent cross contamination of standards and high or level samples by separating the two operations.

The general laboratory space on the other hand should have extensive bench and hood space to permit sample extraction, cleanup and both physical and chemical preparatory procedures. This part of HML should incorporate all necessary preparation steps to characterize solid and liquid hazardous materials according to well referenced methods. The lab must support the needs of the ignitability, corrosivity, reactivity and extraction procedure toxicity test methods and a variety of other characterization procedures published by the USEPA (1982)[5]. Density, compaction testing and bench scale treatment, or fixation experiments, will also be part of the functional uses of this area. Details of these physical separation, treatability evaluation and analysis procedures are provided in section 1.0.5 and 1.0.6.

Table 1.2. Space Designation of Medium to High Hazard Area in Category 3) Space

Area type	Uses	NASF*
High level standard/	Solution preparation, sample standardization, weighing of waste samples, high level standards (fume hood, clean bench)	250
Low level standard/	Solution preparation, sample standardization weighing for environmental media samples, low level standards (fume hood, clean bench)	250
General laboratory area	Solvent extraction, moisture removal, homogenization, extract cleanup and volume reduction, bench-scale treatment, bulk property testing (fume hoods, two walk-in hoods for bench-scale testing)	1000
	TOTAL	1500 ft^2

* Net Assignable Square Feet not associated with hallways, corridors, air locks and buffer zones

It should be noted that all extracts, subfractions or derivatives of hazardous substances which enter HML must remain there until they are officially released. As a minimum, the physical testing of the wastes must be done in the category 3) area to document the gross properties of the materials involved. If hazardous properties are confirmed or suspected on the basis of this testing, then more extensive inorganic and organic chemical analysis (section 1.0.7) will be performed in the category 2) area after appropriate sample preparation. At this point the degree of hazard and the nature/concentration of the components of the waste mixture should be well identified and the material can be released from the facility for other specialized analytical or technical evaluation procedure. The HML will package materials for release or disposal, observing all necessary precautions against personnel exposure or environmental emissions.

1.0.5 PHYSICAL SEPARATION AND ANALYSIS

The physical characterization of hazardous materials is essential to satisfy both the minimum requirements for definition in a regulatory sense and to provide a basis for the evaluation of treatment and disposal alternatives. From the moment of receipt of a hazardous sample at HML, a laboratory chain of custody dossier will be placed in the storage area with copies for each of the levels of containment areas. It will initially detail the origin, source, phase, and estimated degree of hazard associated with it. Each dossier will be supplemented with information on the physical characteristics of importance and further analytical characterization as they are accomplished. The information on the material will further be entered into a computerized laboratory sample tracking system which will contain additional data on precautions and safety information in the event of an accident. An example format is shown in Table 1.3 for the initial information necessary for sample handling in the category 3) area.

Once a sample is to be handled in the bench laboratory area of the category 3) space, a similar data sheet must be developed and updated before the sample enters the analytical/treatment stages. The sample tracking system must be flexible enough to facilitate identification of the general levels of precautions to be taken in handling. It should also provide specific information for remedial action and cleanup in the event of an accident anywhere in the HML facility.

1.0.6 TREATABILITY EVALUATION AND ANALYSIS

We anticipate that bench-scale testing of the waste or material samples for treatability will be conducted in the category 3) area. This will be necessary for the selection of suitable alternative treatment or disposal options based on destruction, stabilization and neutralization efficiency. There are five categories of treatability evaluation which should meet these basic information needs. They are detailed below in Table 1.4.

Table 1.3. Sample Tracking Form A-HML

Sample Identity: HML Tracking No.: xx-xxxx

Source: Contact (Phone): ( )-xxx-xxxx

Sampling Details: (Precautions)

☐ Level A ☐ Level B ☐ Level C ☐ Other

(Remarks): (e.g.) Handling Precautions, Heat/Light/H_2O sensitivity, reactivity, corrosivity

Sample Description:

☐ Solid	☐ Semi-Solid/Sludge	☐ Liquid
☐ Wet/Dry	☐ Organic	☐ Organic/Aqueous
☐ Organic	☐ Inorganic	☐ Inorganic/aqueous
☐ Inorganic	☐ Mixture	☐ Filt./Unfilt.

Physical Characteristics:

Bulk Properties (Solids/Semi-Solids)	Solution Properties
Dry Density	Density
Wet Density	Odor
Odor	% Water
Volatile Content	Flash point (Ignitability)
% Water	pH
Acidity/Alkalinity	Acidity/Alkalinity
Corrosivity	Conductance
Flash point (Ignitability)	TDS
Reactivity	Reactivity
EP Toxicity	EP Toxicity
Structural Integrity	Phase Separation
Mobility	Mobility

Major Likely Hazardous or Toxic Components (Identify and Give Approximate Concentration):

Percent	ppm	ppb
(% to >10,000 ppm)	(≤10,000 ppm)	(≤1 ppm)

Table 1.4. Treatability Evaluation Options

Recycle, Resource Recovery	- solvent/metal recovery - heating value
Neutralization/Reaction	- acidification, basification - precipitation (selective/ nonselective) - stripping methods
Stabilization/Volume Reduction	- chemical stabilization - vitrification - dewatering characteristics
Thermal Destruction/ Residue Characteristics	- pyrolysis - incineration - molten salt methodologies
Novel Treatment Methods	- sodium salt PCB destruction - reaction methodologies - combination treatment procedures (physical/chemical/biological)

The efficiency of various treatment options will be determined by a combination of the treatability bench-work and analytical determinations of the efficiency of toxic component reduction, removal or destruction. The goal of this work is to provide clear guidelines for the environmental and economic evaluation of waste management techniques. We anticipate that HML will be in a position in the future to undertake these types of evaluations for contract sponsors, as well as to support the research program of HWRIC.

1.0.7 ANALYTICAL SEPARATION AND IDENTIFICATION

HML must incorporate an analytical chemistry capability to insure that hazards associated with the screening of waste and environmental media samples can be evaluated both qualitatively and quantitatively. The laboratory will perform screening for the Industrial and Technical Assistance, as well as the Research program areas. Once unknown samples or mixtures are sufficiently characterized, they can then be released to ENR divisional laboratories or those of HWRIC contractors.

It should be clear from the description of existing laboratories (Section 1.2) that no existing or planned facility in state government currently has the overall capability to handle and characterize hazardous samples safely, as well as meet simultaneously their current demands on instrumentation and bench space and those of HWRIC. The HML facility must then be designed and instrumented to provide a self-contained sample handling and analytical capability, in so far as existing labs cannot meet its specialized needs.

The category 2) area in HML therefore should provide space and instrumentation for qualitative and quantitative analysis. The analytical laboratory must be buffered from both the high containment areas in category 3) and the office space usage in category 1). Therefore, only sealed samples of highly toxic materials will enter the analytical laboratory.

The analytical laboratory will provide analytical support services for the research and technical assistance efforts in three functional support roles. These include: elemental analysis, quantitative and qualitative analysis, and structural analysis. the types of instrumentation and techniques which will be undertaken are common to most modern chemical analytical facilities. However, the flexibility necessary to carry out research and service support while maintaining safety and control over toxics' exposure identify the HML analytical facility as a unique capability for the state. Hazardous waste streams or contaminated environmental media (e.g. soil, water, air, biological tissues) present a significant challenge to the achievement of analytical accuracy and precision by standard methods of analysis. Complex mixtures and the simultaneous presence of inorganic and organic forms of toxic or regulated chemical elements cause considerable interference effects which confute standard cleanup, digestion or derivatization procedures. HML staff will therefore have to be highly trained, experienced analysts who can rely upon the rapid retrieval of up-to-date analytical references to meet HWRIC research and support needs.

Approximately 4,000 ft^2 of analytical laboratory and bench space should be provided for a range of spectrometric and wet chemical analysis needs. A proposed design for the analytical facility in category 2) space is shown in Figure 1.2. This layout for the analytical laboratory would allow for maximum utilization of available space with the flexibility for new activities. It would further isolate those procedures which involve direct exposure to toxic solutions or metallic vapors (i.e. wet chemistry and atomic absorption spectrophotometry) from the general instrumentation area.

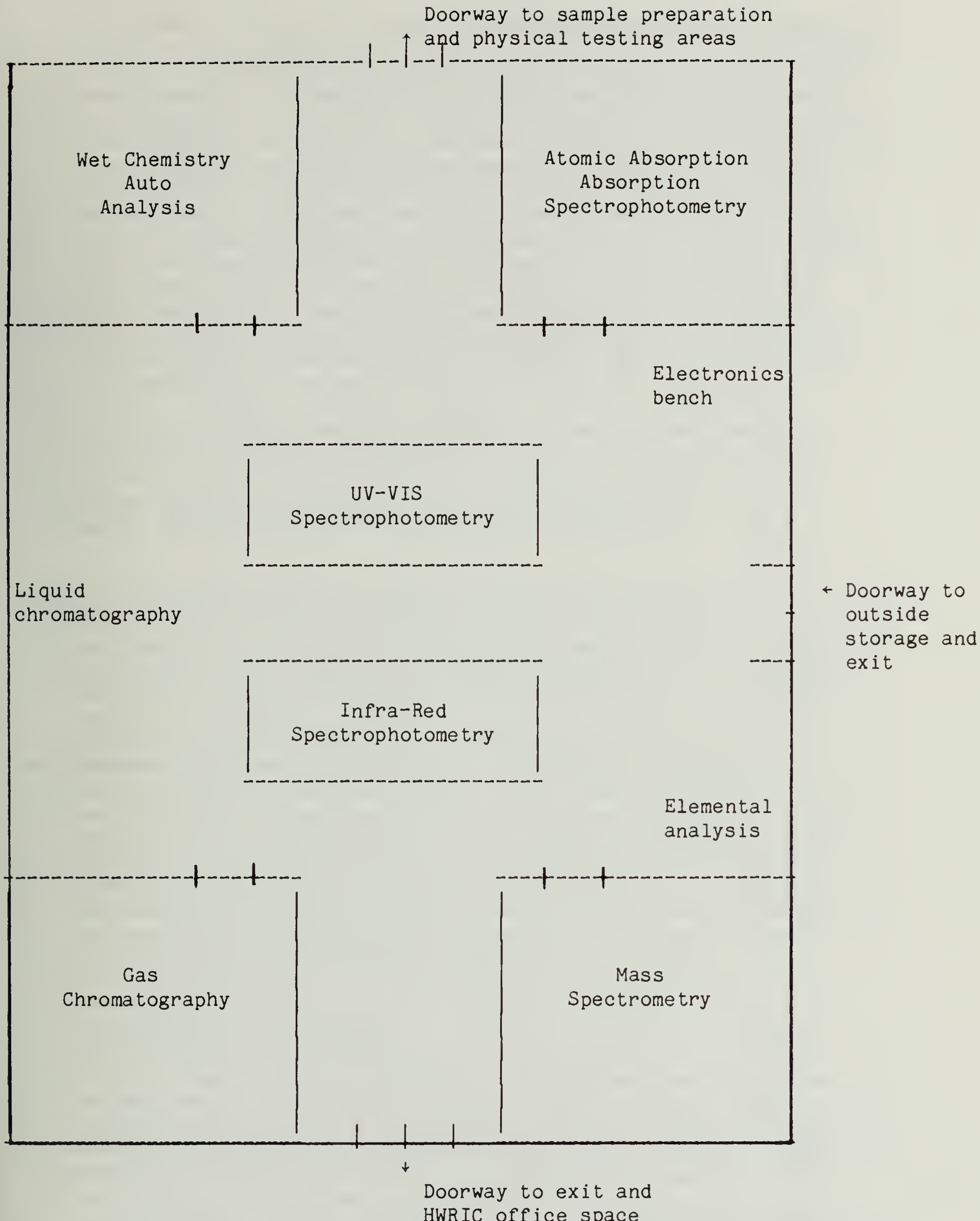

Figure 1.2. Proposed layout of HML analytical laboratory

1.1 FUTURE HML FUNCTIONS AND CAPABILITIES

The technical support, research and information roles of ENR have been limited by laboratory deficiencies. These roles are significantly constrained with respect to hazardous waste problem-solving. Though extramural and federal support has been adequate for specific research programs, much of this equipment is now outdated and insufficient to meet the challenge of the hazardous waste management needs of the state. Aged laboratory facilities and obsolete equipment are simply inadequate for the characterization of waste, air, soil and water samples which contain toxic materials. Waste mixtures and environmental samples frequently contain complex mixtures of toxic organic and inorganic constituents. They must be handled safely and analyzed accurately by state of the art methods. The work is neither routine nor automatic; it takes skilled scientists and modern facilities. Efforts to effectively pursue balanced natural resource and waste management strategies in Illinois require timely, expert advice based on the best available engineering and scientific analysis. Sound analytical results on waste composition, treatment effectiveness and samples from field research investigations are needed now to better plan Illinois' future resource and waste management options.

The first two years of HWRIC operations will be focussed mainly on problem assessment research and limited technical assistance efforts. The HML is essential to the full development of the research and technical programs which the state needs to move towards problem solutions and to adequately plan for the future.

ENR must provide sound technical and scientific information for a variety of user groups. Its existing laboratory capabilities are limited to trace inorganic and organic analytical work on samples which come from natural waters, soils or atmospheric research efforts. The proposed Hazardous Waste Research Laboratory will supplement the department's existing laboratories by including facilities for the detailed analysis and testing of both hazardous waste streams in support of industrial assistance efforts and contaminated environmental samples in support of expanding research efforts. Industrial assistance towards the adoption of alternative technological options demands physical, engineering and chemical analyses to determine the effectiveness and suitability of various treatment and disposal methods. Similarly, field and laboratory studies of the transport, transformation and fate of hazardous substances require specialized analytical facilities. These tasks are nonroutine and call for the cooperation of industry and the capable interdisciplinary staff of the scientific Surveys within ENR to develop satisfactory approaches and solutions to waste-related problems. Laboratory and field methodologies must be developed for a wide range of wastes and waste contaminated samples. These tasks demand research approaches which could neither be undertaken in the routine production-oriented labs which IEPA has, nor in the limited, aging facilities of the scientific Surveys.

The proposed ENR Hazardous Waste Laboratory will serve the research and information needs of developing waste management policy. In this technical support role, the proposed ENR laboratory will permit the handling, characterization and analysis of hazardous waste streams and contaminated samples to provide sound data for several end uses. Wastes will be characterized as to their physical and chemical suitability for various treatment and disposal options. This information will encourage industry to pursue source reduction, recycle, pre-treatment and more environmentally sound disposal techniques. Environmental samples generated in our research and service efforts will be analyzed to determine potential environmental impact and the efficiency of waste management practice. ENR's research activities in physical testing and analytical method development will complement IEPA's efforts to both enforce existing regulations and improve the effectiveness of their toxics' control strategy.

The following sections provide a detailed description of the technical assistance functions which will be supported by HML.

1.1.1 RESEARCH CAPABILITIES AND SUPPORT FUNCTIONS

An active research program attuned to the state's needs is one of the most important parts of the HWRIC effort in the first five years. Initial work on problem assessment will identify the magnitude and extent of our present hazardous waste problems, as well as suggest potential approaches to their solutions. The basic information base is very weak regarding the type, volume and characteristics of hazardous wastes. It is far weaker in the area of understanding the transport, transformations and persistence of toxic substances in the environment. Thus, the implementation of the solutions to our HW problems will require a significant field and laboratory research effort to provide basic data and interpretations. ENR has a number of experienced environmental and basic scientists who are aware of related research efforts underway at academic, commercial and federal government institutions which can enhance our efforts in Illinois. HWRIC research activities will be tailored to the state's needs and will not duplicate efforts which are being pursued at other research centers.

Field Research Activities

Research is needed in the field, plant and laboratory to support basic functions of HWRIC. High priority research task areas are the focus of the HWRIC work plan and will be supported by over half of the Center's noncapital planning budget in the first two years of operation.[6]

Based on the results of the problem assessment research projects in phase 1 of the research plan, the Center's scientific staff and that of contractors will actively pursue research aimed at the investigation of important environmental issues. The

significance and consequences of hazardous and toxic material distributions in our air, soil and water resources must be better understood. Improved techniques for evaluating the efficiency of disposal operations, alternative treatment processes, including methods for materials' flow and economic analyses must be developed. Particularly difficult challenges are presented in studies of waste or disposal stream (e.g. raw wastes, treatment residues and secondary emissions) composition and variations in time. The emphasis should be on mobile, persistent toxic substances and their mode of release into the environment.

Additional research is needed into the distribution of regulated and nonregulated toxic compounds in a variety of environmental media. Sampling, analysis and remedial action methodologies must be developed, field tested and proven to insure that acute, as well as chronic, exposure estimates are well-founded. This is a particularly important area for research study.

It is obvious that the thrust of Federal research programs is on thermal waste destruction methods.[7] Although this is a logical alternative for the ultimate destruction of many hazardous components of waste streams, it is a technologically oriented approach rather than one which addresses the core of the state's HW management problems. With considerable unused incineration capacity in the state and the nation[8], more comprehensive investigations of real costs (both economic and environmental) must be done. HML will support a balanced research program on problems which are unique to Illinois, with its abundance of ground and surface water resources and integrated (industrial/service/agricultural) economy.

Waste Treatment Research Activities

Applied chemical and engineering research will be undertaken by HWRIC on the effectiveness of waste reduction and alternative treatment options for HW management. Engineering studies will be conducted on waste compatibility, dewatering and pretreatment needs for solvent and metal recovery techniques. Methods of upgrading the recycle and resource recovery potential of high volume, hazardous waste streams must be investigated. Similarly, waste preparation techniques for solidification and combined physical, chemical and biological waste treatment operations must be developed.

Chemical research into waste characterization and analysis methodologies is needed where the techniques have been demonstrated at bench or pilot scale, yet full implementation has been hampered by incomplete evaluation of energy and resource inputs or net efficiencies. Sampling methods for waste characterization, homogenization or separations prior to analysis need to be studied in detail. Generalized protocols for dealing with "unknowns" or waste streams which are variable in composition from a regulatory point of view demand more careful study.

1.1.2 TECHNICAL ASSISTANCE CAPABILITIES AND SUPPORT FUNCTIONS

In addition to supporting the research activities of HWRIC, the functions of HML must address the technical assistance needs of Illinois industry and state government agencies. Many industrial generators of hazardous waste in Illinois are small operations which may be undercapitalized or understaffed to conduct comprehensive waste treatment evaluations. For example, electroplating, heat-treating and metal-finishing operations can be encouraged to adopt waste reduction or other disposal alternatives if proof of concept investigations can be supported. In the long run, the state will be far better off if these industries can be convinced that environmentally sound, economic alternatives exist. The Industrial and Technical Assistance program area will work cooperatively with industrial trade groups to promote more sensible waste management alternatives. A sophisticated sample handling and analysis facility such as HML will be a valuable resource for this effort. It is anticipated that industry support for these HWRIC activities can be attracted and retained to sustain many of HML's support needs. It is incumbent on the part of the staff to demonstrate the value of these assistance efforts from the outset if additional support is to be realized.

State and federal government agencies also have the need for both research and technical assistance resources. With ENR's demonstrated expertise in research, planning and resource conservation programs, the capabilities of HML will certainly improve our ability to attract funding in these areas. HWRIC staff and HML facilities will further provide the high level advice, consultation and analytical support upon which the IEPA and other state agencies cannot presently rely as they approach complex HW related problems. The sophisticated analytical work required by IEPA in its regulatory and environmental protection efforts must presently be contracted out. HML can fulfill these needs in a rapid, uniform manner that contracting on a demand basis makes difficult, if not impossible, within time and fiscal restraints. Strict confidentiality will be maintained between the various HML support functions for research, industrial and state government needs. The products of HML work must further be of the highest quality possible and responsive to the needs of Illinois' user communities.

1.2 CURRENT STATE LABORATORY FUNCTIONS AND CAPABILITIES FOR HAZARDOUS SAMPLE ANALYSIS OR CHARACTERIZATION

1.2.1 GEOLOGICAL SURVEY (SGS)

Sampling and Sample Preservation

The Geological Survey has sampling capabilities for lakes and rivers, including sediment coring, collection of surface samples, and water samples. Drill rigs are available for subsurface coring. Ground water and gas sampling equipment are available. Facilities for preservation of samples by freezing or refrigeration are extremely limited and inadequate for any large-scale sampling program.

Gases. Gas sampling procedures have been developed for natural gas and collection of gases from core samples. Gas sample analyses for low molecular weight hydrocarbons are routinely made at the SGS oil and gas laboratory by gas chromatography.

Liquids (waste streams, ground water). The Hydrogeology Section maintains ground water sampling equipment suitable for collection of samples for chemical analysis. Surface water samples, brine samples and coal cleaning waste solutions have been analyzed by the Analytical Chemistry Section for major, minor and trace elements.

Sludges. Sludge samples have been collected in the Upper reaches of the Illinois River, coal ash ponds and lime slurry pits. Sludges, once dried, are treated like solid samples.

Solids. Sediments, soils and geologic materials are routinely sampled and analyzed by the SGS.

Biological Tissues and Extracts. The SGS has an active microbial geochemical laboratory with experience in isolation and identification of bacteria in natural systems.

Safety Equipment. Safety procedures were developed for working at both Wilsonville and Sheffield waste sites. Laboratory safety suffers from overcrowded laboratories, inadequate fume hoods, lack of any clean benches and no space for preparing hazardous waste samples in isolation. Solvent and reagent storage space is substandard.

Sample Storage. Space is inadequate for storage of anything but a small number of samples in a refrigerated space.

Sample Preparation and Preconcentration. Sample preparations for inorganic analyses is limited largely by space. Adequate hoods for acid digestion are not available. Areas for drying and grinding of samples in "clean" conditions are not available. The

conditions for organic compound determinations are even more severely space limited.

Analytical Separation and Identification. The Analytical Chemistry Section and the Geochemistry Section maintain approximately 12,000 ft^2 of combined laboratory and office space. The laboratories are equipped for inorganic analysis with equipment that ranges from current state of the art to that in excess of twenty years old (see Table 1.5 below). The demands on the analytical facilities are very high. Current demands from extramural and state supported research programs is very high. Equipment upgrade in X-ray fluorescence and X-ray diffraction are especially critical at this time. Also, the combined capabilities of the three state Surveys to undertake gas chromatography/mass spectroscopy investigations is very limited. Various investigators within the Geological Survey have sought funding for a state of the art bench-top HP 5970B or HP5995C GC/MS. It is the collective opinion of staff members that such an instrument would greatly expand our analytical capabilities and would be necessary for definitive identification of organic compounds. However, current attempts to acquire funding for such an instrument appear bleak.

Table 1.5. State Geological Survey Equipment Detail

- X-ray Fluorescence (XRF)
  - Phillips PN1540 Vacuum X-ray spectrometer
- Atomic Absorption Analysis (AA)
  - Perkin-Elmer Model 306 and Model 360 Atomic Absorption Spectrophotometers
- Energy Dispersive X-ray Fluorescence (EDX)
  - Kevex Si(Li) Detector with 155 ev (FWHM) at 5.9 kev, 300 MCi ^{241}AM source, Tracor Northern 1700 ADC
- Optical Emission Spectrochemical Analysis (OE)
  - Ebert-mount Spectrograph, Jarrel Ash 3.4M
- Instrumental Neutron Activation Analysis (INAA)
  - 2 Ge(Li) Detectors, 15% efficiency, 2 Tracor Northern Scientific 770 pulse-height analyzers with 4096 channel memories, Northern Scientific 408C tape control, Wangco Mod 7 tape deck, 2 automatic sample changers, one 300 mm^2 intrinsic germanium detector, nuclear data ND66 multi-channel analyzer.
- Low Level Radioactivity
  - Gamma Products G4000 low level alpha beta gas flow proportional counter
- Elemental Analysis (Carbon)
  - Coulometrics 5010 CO_2 coulometer, 5020 total carbon apparatus, 5022 TC kit ladle, 5030 carbonate carbon apparatus, and Dohrman Carbon Analyzer

(concluded on next page)

Table 1.5 (concluded)

X-ray Diffraction (XRD)
- Phillips Norelco X-ray diffractometer, graphite monochromator

Ultra Violet-Visible Spectrophotometry (UV-VIS)
- Hitachi 100-40 Spectrophotometer

Infra-red Spectrometry (IR)
- Perkin-Elmer 21

Gas Chromatography (GC)
- Perkin-Elmer Sigma I, dual EC detectors with capillary column injector (3)
- (3) Perkin-Elmer Sigma I systems with FID and TC detectors (one with cryogenic oven)
- Hewlett-Packard 5840A reporting GC, EC and dual FID detectors, capillary column inlet
- Tracor 542, equipped with photoionization detector and Tracor 700A Hall detector
- Perkin-Elmer, equipped with dual ^{63}Ni electron capture detector and capillary column injection port
- Hewlett-Packard, equipped with dual flame ionization detector and ^{63}Ni electron capture detection and capillary column injection port
- Perkin-Elmer 3920B interfaced with a Sigma 10 microprocessor, FID, and FPD detector, solid sample injector and pyroprobe accessory
- High Pressure Liquid Chromatography (HPLC)
  - Perkin-Elmer Series 3, microprocessor controlled

Ion Chromatography
- Dionex Ion Chromatograph 2110i equipped with AS-5 column

Miscellaneous Equipment
- Analytical balances, water baths, hot plates, muffle furnaces, drying ovens, centrifuges, sample pulverizing equipment, fluoride ion selective electrode, mercury by cold vapor atomic absorption, pH meters, freeze dryer, Amicon molecular weight ultra-filtration unit, Tekmar LSC-2 liquid sample concentrator

1.2.2 NATURAL HISTORY SURVEY

<u>Sampling and Sample Preservation</u>

The Natural History Survey has sampling capabilities for: aquatic ecosystems, including surface and subsurface water, surface sediments, sediment cores, aquatic plants (from phytoplankton to macrophytes) and aquatic animals (from zooplankton to fish); terrestrial ecosystems, including surface and subsurface soils, terrestrial plants and terrestrial animals. Facilities are available for freezer and refrigerator storage of samples. However, these storage facilities may become limiting if sample numbers and/or sizes are very large.

Gases. The Natural History Survey presently has no capabilities for collecting, facilities for storing, or equipment for analyzing gaseous samples.

Liquids (Waste Streams, Ground Water). The Analytical Chemistry Laboratory (Section of Wildlife Research) maintains surface and deep water sampling equipment suitable for collection of samples for chemical analysis. Chemical analysis capabilities include major, minor and trace elements, pesticides, and PCB's. The laboratory presently has no facilities for detecting volatile organic pollutants. The Analytical Chemistry Laboratory (Aquatic Biology Section) has full capabilities for water quality determinations.

Sludges. Sludge samples have been collected from various sources, including municipal sewage systems. The fluid phase is treated as a liquid sample; the particulate phase, after drying, is treated as a solid sample.

Solids (Waste Solids, Soils, Sediments). The Natural History Survey sediment sampling capabilities are limited to grab and gravity coring equipment operable in surface waters less than 50 feet in depth. Sediments, soils, and other solid samples are analyzed for major, minor and trace elements, pesticides, and PCB's.

Biological Tissues and Extracts. The Analytical Chemistry Laboratory (Section of Wildlife Research) is fully capable of analyzing various biological tissues, fluids, and extracts for a broad spectrum of parameters. These include heavy metals, pesticides, PCB's, organic nitrogen, potential energy (oxygen bomb calorimetry), digestibility, and a number of biochemically important components (e.g. in blood or serum).

Safety Equipment. Standard laboratory safety equipment is available and maintained on a regular basis. Standard laboratory safety procedures are adhered to quite rigorously. A request for additional and replacement fume hood equipment has recently been

submitted for consideration. The laboratory is not presently equipped to handle and isolate samples containing the more noxious hazardous materials such as dioxins. Standard field safety procedures are adhered to.

Sample Storage. Sample storage capability includes several upright and chest-type freezers, several refrigerators, and two walk-in cold rooms. A walk-in freezer room would be desirable. At present, storage space is not limiting, but this may become the case if sample collections are excessively large.

Sample Preparation and Preconcentration. Techniques and equipment are available for the preparation of soil, water, and biological materials to be extracted by mixing with organic solvents. Soxhlet extractors are also available. Concentration is handled by steam baths and Snyder distillation columns. Five explosion-proof hoods are available. These capabilities are maintained by the Analytical Chemistry Laboratories and the Pesticide Chemistry and Toxicology Laboratory.

Sample preparations for inorganic analyses are carried out in a low-pressure acid preparation room equipped with two fume hoods. The hoods are not acid-resistant but are protected to some extent by the use of a water aspirator-evacuated bell mounted above the acid digestion unit. A request for a perchloric acid hood has been submitted for consideration.

Sample preparations for organic analyses are carried out at standard laboratory benches; concentration and fractionation procedures are performed in a standard fume hood equipped with a steam bath. Because fume hood space for organic sample preparation is at a premium, a request for a second hood has been submitted.

Analytical Separation and Identification. The two analytical chemistry laboratories (Wildlife Research and Aquatic Biology) maintain approximately 2500 sq. ft. of combined laboratory and office space. The laboratories are equipped for inorganic and organic analyses with apparatus and equipment that range from fairly recent to in excess of 15 years old. Equipment upgrading is an urgent priority if the current workload alone is to be maintained. The implications for additional workload assignments are obvious. Most qualitative and quantitative analyses are handled by gas-liquid chromatography. A UV spectrophotometer is used infrequently for qualitative analysis, but more frequent for monitoring enzyme-substrate reactions. A mass spectrometer is available in the NHS but is unreliable for routine analyses of trace contaminants (A major equipment listing is shown in Table 1.6).

Physical Separation and Analysis. No capability available at NHS.

Treatability Evaluation and Analysis. No capability available at NHS.

Table 1.6. State Natural History Survey Division
Illinois Department of Energy and Natural Resources
Analytical Chemistry Laboratories/Pesticide Chemistry
and Toxicology Laboratory

MAJOR EQUIPMENT

Spectrophotometry

UV/Vis.	Beckman spectrophotometer with recorder Bausch & Lomb Spectronic 100 spectrophotometer Perkin-Elmer Coleman 295 spectrophotometer Perkin-Elmer 1240 spectrophotometer
AA	Instrumentation Laboratories Model IL253 and IL351 atomic absorption spectrometers Perkin-Elmer Model 303 atomic absorption spectrophotometer with Delves cup attachment Fisher HG-3 Mercury Analyzer (cold-vapor)
AE	Jarrell-Ash Model 975 AtomComp inductively coupled argon plasma spectrometer
Fluor.	Aviv Hematofluorometer (calibrated for waterfowl protoporphyrin determinations)
IR	Perkin-Elmer spectrophotometer

Chromatography

GC	Varian Aerograph Series 2100 gas chromatograph with electron capture detector Varian 2100 with alkalai flame ionization detector (AFID) and two ^{63}Ni electron capture detectors (ECD). Four column capacity, temperature programmer. Used for the analysis of chlorinated pesticides, derivatized carbamates, nitrogen and phosphorus containing pesticides. Varian 1400 with AFID. One column capacity, temperature programmer. Used for the analysis of nitrogen and phosphorus containing pesticides. Packard 428 with nitrogen-phosphorus detector (NPD) and ECD. Two column capacity with temperature programmer. Same uses as above. Tracor 550 GC modified with two Varian ECD cells and Keithly electrometer. Two column capacity, isothermal operation. Used for chlorinated pesticides.

Radiochemistry

Beta	Packard Tri-Carb Liquid Scintillation Spectrometer Model 3320 Packard Model 306 Sample Oxidizer

Thermochemistry

Energy	Parr Model 1341 Oxygen Bomb Calorimeter

(concluded on next page)

Table 1.6. (concluded)

GENERAL APPARATUS AND MISCELLANEOUS EQUIPMENT

Digestion Apparatus (Kontes microKjeldahl digestion apparatus, Hach Digesdahl digestion apparatus); Stills (Corning glass still, quartz still)

Sorvall superspeed refrigerated centrifuge, Oceanography International Total Carbon System, Metrohm Autotitrator, Technicon Autoanalyzers, pH meters, oxygen meters, vacuum pumps, water baths, drying ovens, analytical balances and other general laboratory equipment (mixers, shakers, hot plates, etc.)

1.2.3 WATER SURVEY (SWS)

The Water Survey currently occupies over 28,000 ft^2 of office and laboratory space in four buildings in Champaign, and another at the U/I Willard Airport. Field offices are maintained in Peoria and Batavia. The Champaign headquarters facilities have long been staffed at or above capacity. This has resulted in the conversion of storage space to laboratories and general use space (e.g. conference room) to office space. The laboratory and office space available presently to the main laboratory groups is less than 6,000 ft^2. The planned remodeling of the former Adler Zone Center will result in little net gain of space and a net loss of laboratory storage, and office space for the two chemistry laboratory groups. The improved design of the remodeled areas, to be available in late 1985, should enable better usage of the laboratory areas. However, these laboratories are optimized for trace constituent analytical work and cannot safely accommodate hazardous materials' characterization. Further, there will be no additional office space available for HWRIC personnel.

Since the Water Survey is the host division of the Center, it would be best to have the HWRIC staff and the proposed HML located adjacent to the Adler complex. A large area of open land is located east of the laboratory building at the Adler site. currently, there are no University or State Buildings within a half-mile radius which are available to the Water Survey and suitable for HWRIC operations (see site evaluation section 1.3.1).

The remainder of this section details the functional laboratory capabilities of the Survey which relate to HML activities.

<u>Sampling and Sample Preservation</u>. Current SWS capabilities in sampling and sample preservation are limited to ground-water and sediment sampling. Facilities for the effective sampling and preservation of gases, sludges and biological specimens have been constructed or prepared on a demand basis.

Gases (Toxic Vapors, Atmospheric Sampling). The Aquatic Chemistry Section (ACS) has developed capabilities for the collection and analysis of fixed, noncorrosive gases in ground-water and sediment pore waters. Routine analyses are performed for N_2, CO_2, O_2, and C_1-C_4 hydrocarbons. A field toxic vapor analyzer and photoionization detector equipped portable GC would be needed. Well developed facilities exist for aerosol and precipitation sampling in the Atmospheric Chemistry Section. Gas sampling and analysis, particularly for organic compounds, is lacking.

Liquids (Waste Streams, Ground Water). The ACS and Ground Water Sections maintain a large array of ground-water sampling equipment suitable for the collection of samples for a wide range of chemical parameters. This equipment includes 13 sampling pumps and two flow-through well head devices for pH, Eh, T, Ω^{-1} determinations. Field analytical gear is limited to oxygen (2) and alkalinity determination rigs. Most of this gear is committed to the

contractual agreements on which the equipment was purchased through June of 1986.

Sludges. No capability.

Solids (Waste Solids, Soils, Sediments). Sediment sampling gear at the SWS is limited to grab and depth-integrated sampling of sediments in surface waters. Limited gravity coring apparatus is available for surface waters less than 50 feet in depth.

Biological Tissues and Extract. No capability.

Safety Equipment. No field capability. All safety equipment is laboratory operation oriented.

Sample Storage. Sample storage capability is limited to 500 ft^3 of nonfireproof, refrigerated space for water samples and sediment cores.

Sample Preparation and Preconcentration. Sample preparation facilities are limited to six thimble-type Soxhlet extraction setups for sediments. Sample preconcentration apparatus are limited to manual liquid-liquid extraction units for water samples and 6 Kuderna-Danish solvent reduction units which are set up on a demand basis in multi-use laboratory space. A single 4' fume hood (conventional) is available for these operations which is neither explosion proof, nor equipped to contain spills or flames.

Analytical Separation and Identification. The Analytical Chemistry Unit and the ACS maintain approximately 3,000 ft^2 of combined laboratory and office space (occupied by junior staff). The labs are currently occupied by contractual research commitments and totally inadequate for the storage and handling of hazardous materials or unknowns. Solvent and reagent storage space is substandard.

Liquid and Gas Chromatography, Elemental Analysis. (see equipment detail, Table 1.7)

Structural Analysis (Gas Chromatography/Mass Spectrometry). A small gas chromatography system equipped with a mass selective detector is maintained by the ACS. It has been modified with purge and trap/cryogenic focussing modifications to optimize its use for determinations of volatile organic compounds in water samples. It's limited mass range (0-800 amu) and data handling capability permits the structural confirmation of the current priority pollutants accessed by the EPA 624,625 methodologies.

Physical Separation and Analysis. No capability available at SWS.

Treatability Evaluation and Analysis. No capability available at SWS.

Table 1.7. State Water Survey Division
Illinois Department of Energy and Natural Resources
Analytical Chemistry Unit/Aquatic Chemistry Section

MAJOR EQUIPMENT

Spectrophotometry

UV-VIS	Beckman DB-G, Beckman DU with Update® electronics, Perkin-Elmer Lambda III and three solid-state colorimeters
Fluorescence	Turner Model 111
Atomic Absorption	Instrumentation Laboratory-Models, 951, Video 22 and 151 instruments, with both graphite furnace and flame capability; Perkin-Elmer 380

Chromatography

HPLC	Perkin-Elmer Sigma III-B, with gradient capability and variable wavelength UV-VIS and fluorometric detectors. Altex Model 110A, with electrochemical detection capability
GC	2- Varian 3740 dual capillary column instruments, with Hall, ECD, FPD and FID detectors, coupled to a VISTA 402 data system. One system includes a purge and trap unit.
	2- Isothermal GC's for fixed gas and hydrocarbon determinations, with TC and FID detectors
GC/MS	Hewlett-Packard 5790 dual capillary column instrument, with FID and mass selective detectors, also equipped with capillary interfaced, purge and trap unit.
Misc.	2- Hewlett-Packard 3390A integrators: 4 strip chart records and 3 fraction collectors

Electrochemistry

ASV, DPASV Polarography	1- PAR Model 174/153 polarographic analyzer with Model 315 controller, and linear sweep module, rotating, HMDE, static Hg drop electrodes and Houston-Omnigraphic X-Y recorder
pH, ISE	3- Orion #231, 2- Corning research grade pH meters, 2- Orion research grade pH meters, 2- Orion #399A field pH meters, 4-utility pH meters. 1- Metrohm titration system
Conductance	2- Altex/Beckman RC-16C field conductivity meters, 2- laboratory conductivity meters

Elemental Analysis

Organic Carbon	1- O.I. Corp. Model 524 Total Carbon Instrument, modified to permit VOC determinations

Automated Analysis

Anions, Nutrients	2- Technicon AutoAnalyzer systems 2- Dionex ion chromatographs

MISCELLANEOUS EQUIPMENT

Freeze dryer, vacuum pumps (2), Kjeldahl unit, analytical balances (5), amperometric titrator, water baths (3), dissolved oxygen meters (2), Winkler O_2 field kits (2), muffle furnace, drying ovens (5), sample preparation and extraction racks, digestion apparatus, clean benches.

1.2.4 ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

The Illinois Environmental Protection Agency maintains organic analytical capabilities at the Springfield headquarters and mainly inorganic analytical capability at the Champaign and Chicago laboratories. These laboratories have been designed and operated principally for the routine determination of regulated chemical constituents in natural waters, soils or air samples by standardized analytical procedures. The bulk of the analytical work conducted by the Agency is done in support of their regulatory, enforcement and compliance monitoring programs. Their facilities and support have severely limited the rapidity of reporting analytical results. For certain parameters (mainly the organic priority pollutants) the backlog of samples frequently extends the sample turn around time to several months. This situation was anticipated as early as 1978 when expanded organic analytical facilities were planned in a joint facility to be shared with the Southern Illinois University School of Medicine and the Illinois Department of Public Health. The construction of this facility is slated to begin in late '84 or early '85. It will be located in Springfield.

The proposed facility will expand their current laboratory space in Springfield from ~4,000 ft^2 to 6,500 ft^2. The new facility will allow for essentially no new applications over that permitted by their current analytical capabilities. It should, however, provide improved utility of their available space and more secure, safe handling of highly contaminated samples. The Agency will have limited-access storage areas to maintain chain of custody and segregated sample and standard storage so that contamination of low level samples is not jeopardized by either solvent or reagent storage, as well as samples which are likely to be contaminated with highly toxic materials. In addition, the new facility will have well-designed sample preparation areas for solvent extraction and cleanup which will separate background level sample preparation from that of contaminated samples.

The very large number of routine samples that the Agency receives to conduct its regulatory functions requires absolute control over sample tracking and the standard analytical protocols. The currently planned expansion will not permit research oriented analytical work. The Agency must limit the number of samples submitted by potential external users in order to keep up with the ever-increasing sample load. At present, the Agency is constrained to send out nonroutine sample analyses to external contract laboratories at considerable cost. It is clear that a well-designed state research laboratory, capable of handling specialized analytical requests for hazardous materials, would be helpful to IEPA. In the past, the divisional laboratory capabilities of ENR have provided limited support to the Agency along these lines. However, samples contaminated with toxic unknowns or extremely hazardous materials cannot be accepted presently.

The IEPA's role in the Chemical Safety Research Initiative (CSRI) calls for an expansion of their toxicological testing capabilities. This new activity will be housed in the Chicago laboratory until the Springfield facility has been completed and the Toxicology Testing Program can be moved into the headquarters laboratory area. A profile of both aspects of the CSRI is provided as a table, detailing the differences between the HWRIC capability and that to be developed by IEPA (see Table 1.8).

Table 1.8. Chemical Safety Research Center Laboratory Facilities' Profile

	ENR	EPA
Program:	Hazardous Waste Research and Information Program	Toxicology Testing Program
Aim:	Research and Information	Enforcement, Regulation, Monitoring and Remedial Action
Primary Goal:	Provide quantitative and qualitative characterization of waste streams and environmental samples to encourage the adoption of environmentally sound HW management practices	Improve the efficiency and relevancy of enforcement, regulatory and monitoring efforts by focussing on immediate toxic materials of concern
Primary Need:	Safe handling, chemical and physical testing capabilities for the characterization of highly toxic waste samples and modern facilities for the specialized goals of new HW research programs	Well-designed facilities and instrumentation to permit aquatic toxicity and mutagenicity assays on waste and environmental samples by proven bioassay methods
Primary Responsibilities:	Provide hard data on waste stream treatability and efficiency of treatment or disposal options to industry, government and the research community. Provide analytical support to the state's research and service programs in HW problems.	Provide specific toxicity assessments of various waste fractions, soil or water samples to insure that regulation and enforcement tasks have the maximum immediate effect to reduce public and environmental exposure to toxic substances
User Groups; Primary:	Industry, Researchers, Government	IEPA, IPCB, IDPH, Government and Enforcement Staff
Secondary:	IEPA, IDPH	Local Public Health Agencies, Public

1.3 RECOMMENDATIONS AND CONCLUSIONS

1.3.1 SITE EVALUATION

The Scientific Surveys have been allied agencies of the University of Illinois, Urbana-Champaign since the times of their inceptions in the late 1800's. Since then, the physical facilities of the Surveys' headquarters have been provided by the University. The appropriate university authorities, involved with space utilization, have been contacted regarding the short and long-term facilities' needs of HWRIC.

The requests were predicated on the need for interim office space in the proximity of the host division (ISWS) of at least: 1500 ft^2 in FY '85 and 2500-3000 ft^2 in FY '86. The FY '87 need for a hazardous materials laboratory and office facilities totalling about 12,000 ft^2 was also made known to Mr. William Stallman of the U/I Office of Space Utilization. The availability of either short-term or long-term university space for the needs of HWRIC are extremely limited. We have been informed that the only hazardous materials' laboratory on campus is heavily used in the biological sciences on work with pathogenic materials. The possibility of HWRIC access to these facilities is very remote, even for limited use. This is due to the incompatibility of hazardous vapors or aerosols with their biological containment procedures.

The U/I has no other space suitable for renovation, sufficient to the needs of HWRIC within a half-mile of the Water Survey Division's present or future home. In the absence of state supported space in the vicinity of the Water Survey's new facility at the former Adler Zone Center, the needs of HWRIC must be met by the construction of a new facility.

1.3.2 SUPPORTING INFORMATION FOR SITE EVALUATION

(See letter on following pages)

University of Illinois at Urbana-Champaign

OFFICE OF SPACE UTILIZATION · 243 DAVENPORT HOUSE · 807 SOUTH WRIGHT STREET · CHAMPAIGN, ILLINOIS 61820
(217) 333-1234

August 29, 1984

Mr. Michael J. Barcelona, Acting Director
Hazardous Waste Research and Information Center
Water Resources Building
605 E. Springfield Avenue
Champaign, Illinois 61820

Dear Mr. Barcelona:

This is in response to your August 16, 1984 letter to me in which you asked for information on the following:

1) Current availability of a hazardous materials handling and analysis laboratory for your use;

2) Present availability of a University building, capable of housing ~15 offices and suitable for renovation to a high level self-contained hazardous materials laboratory of 5,000-10,000 square feet, and

3) Future availability of a University building, capable of housing ~15 offices and suitable for renovation to high level self-contained hazardous materials laboratory of 5,000-10,000 square feet.

I'm sorry to report that I cannot identify any University-owned or leased facilities that could meet any of your needs--now or in the future. The University is currently leasing over 100,000 net square feet of space to meet its own needs, and we still have numerous units (Computer Science, Life Sciences, Chemical Sciences) short of space. Therefore, the answer to your first two questions is clearly no, we do not have any existing facility that could meet the needs or be remodeled to meet the needs of your hazardous materials handling and analysis laboratory. In fact, the Fire Training office space on Wright Street that I mentioned as a possibility will be assigned to Computer Science as soon as it is vacated. Thus, I cannot even loan that space to you on an interim basis.

As to the third question, I also do not see any potential space becoming available to meet your needs in the future. In fact, I cannot identify any space--regardless of potential--that will be unneeded within the next five years. I say this because of the high demand being placed upon our College of Engineering, College of Commerce, and Schools of Life and Chemical Sciences. All of these units--except for the College of Commerce--require considerable laboratory space, and we are simply not able to satisfy those demands.

In summary, I must regretfully state that I do not believe the University of Illinois at Urbana-Champaign can provide sufficient space to the Water Survey for accommodating the Hazardous Waste Research and Information Center, even if the Water Survey had sufficient funds to remodel the space to proper quality. Unfortunately, it appears that space has become one of our most critical resources, and there appears to be no apparent relief in sight.

Sincerely yours,

W. E. Stallman

William E. Stallman
Director

WES:as

cc: T. L. Brown
J. M. Cain
S. A. Changnon
E. L. Goldwasser
R. J. Schicht

1.4 REFERENCES

1. McKusick, B. C. 1981. Prudent Practices for Handling Hazardous Chemicals in Laboratories. Science 211, 4484, 777-780.

2. Hill, R. H., Jr. 1981. Control of Hazardous and Toxic Materials in the Laboratory. American Laboratory, July, 14-22.

3. Michelotti, F. W. 1979. Hazardous Chemical Safety in the Laboratory. Analytical Chemistry 51, 4, 441A-456A.

4. Harless, J. M., Baxter, K. E., Keith, L. H., Walters, D. B. 1980. Design and Operation of a Hazardous Materials Laboratory. Chapter 4 in Safe Handling of Chemical Carcinogens, Mutagens, Teratogens and Highly Toxic Substances. Volume 1, D. B. Walters, editor, p. 79-100, Ann Arbor Science Publishers, Ann Arbor, MI, 379 pp.

5. EPA. 1982. Test Methods for Evaluating Solid Waste: Physical and Chemical Methods. SW846 2nd Edition. Office of Solid Waste and Emergency Response, Washington, D.C. 20460.

6. Hazardous Waste Research and Information Center. 1984. Plan for FY '85, SWS Report HWRIC-001, Champaign, IL, July 1984, 33 pp.

7. Josephson, J. 1984. Hazardous Waste Research. Environmental Science and Technology 18, 7, 222A-223A.

8. Keitz, E., G. Vogel, R. Holberger and L. Boberschmidt. 1984. A Profile of Existing Hazardous Waste Incineration Facilities and Manufacturers in the U.S. EPA 600/52-84-052. USEPA-IERL, Cincinnati, OH, April 1984.